EXHIBIT 5

Exhibit F4-008O
Invalidity of U.S. Patent No. 8,090,008 based on Mestdagh

"A Method to Reduce the Probability of Clipping in DMT-Based Transceivers" by Denis J. G. Mestdagh and Paul M. P. Spruyt ("Mestdagh"), was published in IEEE Transactions on Communications, Vol. 44, No. 10, Oct. 1996. Mestdagh is therefore prior art to U.S. Patent No. 8,090,008 ("the '008 Patent") under at least 35 U.S.C. §§ 102(a), (b), and/or (e).

This invalidity claim chart is based in whole or in part on Nokia's present understanding of the asserted claims, its current construction of the claims, and/or TQ Delta's apparent construction of the claims in its current infringement contentions. Nokia is not adopting TQ Delta's apparent claim construction, nor admitting to the accuracy of any particular claim construction. To the extent that TQ Delta's apparent claim construction or applications thereof are reflected in this invalidity claim chart, nothing herein should be construed as an admission that Nokia agrees with TQ Delta's apparent claim construction or TQ Delta's application of that claim construction in TQ Delta's current infringement contentions.

The use of this reference or combinations of references as invalidating prior art under 35 U.S.C. §§ 102 and/or 103 may be based on TQ Delta's allegations of infringement. Nokia does not necessarily agree with the interpretations set forth in TQ Delta's infringement contentions and thus this invalidity claim chart is not an admission that the accused products meet any particular claim element or infringe the asserted claim. In addition, nothing in this invalidity claim chart should be interpreted as a position about whether any portion of the asserted claim is limiting or not. Further, by submitting this invalidity claim chart, Nokia does not waive and hereby expressly reserves its right to raise other invalidity defenses, including but not limited to defenses under 35 U.S.C. §§ 101 and/or 112.

Nokia reserves the right to amend or supplement this claim chart at a later date.

Claim 14	**Mestdagh Disclosure**
[14-pre] A multicarrier system including a first transceiver that uses a plurality of carrier signals for modulating a bit stream, wherein each carrier signal has a phase characteristic associated with the bit stream, the transceiver capable of:	To the extent that the preamble is deemed limiting, under at least TQ Delta's apparent theory of infringement, Mestdagh discloses and/or renders obvious "a multicarrier system including a first transceiver that uses a plurality of carrier signals for modulating a bit stream, wherein each carrier signal has a phase characteristic associated with the bit stream:"

	008G; F4-008I – F4-008L; F4-008N – F4-008P and F4 Secondary - 008 teach this limitation. It would have been obvious to one of ordinary skill in the art to combine the teachings of Mestdagh with any of these references, as they all teach methods or devices that compute a phase shift for each carrier signal based on the value associated with the carrier signal. For additional motivation to combine, see limitation 14[A].
[14C] combining the phase shift computed for each respective carrier signal with the phase characteristic of that carrier signal to substantially scramble the phase characteristics of the plurality of carrier signals, wherein multiple carrier signals corresponding to the scrambled carrier signals are used by the first transceiver to modulate the same bit value.	Under at least TQ Delta's apparent theory of infringement, Mestdagh discloses and/or renders obvious "combining the phase shift computed for each respective carrier signal with the phase characteristic of that carrier signal to substantially scramble the phase characteristics of the plurality of carrier signals, wherein multiple carrier signals corresponding to the scrambled carrier signals are used by the first transceiver to modulate the same bit value": ***Abstract*—A new method allowing a reduction in the probability of clipping in discrete multitone (DMT)-based transceivers is described. The method does not use any kind of precoding and can easily be implemented within conventional DMT-transceivers. The main advantage of the proposed method is an improvement of system performance in terms of overall signal-to-noise ratios (SNR's): with the simplest implementation option of the proposed method, up to about 8 dB improvement in the SNR as compared with previously reported brute force clipping methods can be achieved.** *See, e.g.*, Mestdagh at Abstract.

THE *discrete multitone* (DMT) modulation technique is emerging as a very powerful technique for applications ranging from asymmetric digital subscriber line (ADSL), digital audio broadcast (DAB) to interactive video on demand (IVOD) over CATV networks [1]–[3].

A DMT signal is the sum of N independently quadrature amplitude modulated (QAM) signals each being carried over a distinct carrier frequency. The frequency separation of the N carriers is equal to $1/T$ where T is the time duration of a DMT symbol. The real part of the complex envelope of the generated DMT signal can be expressed as

$$A(t) = \mathrm{Re}\left\{ \sum_{m=-\infty}^{+\infty} \sum_{k=0}^{N-1} [r_m^k \cdot e^{j2\pi(k/T)t} \cdot u(t - mT)] \right\} \quad (1)$$

where r_m^k denotes the QAM-phasor of carrier k (at frequency k/T) of the m-th DMT symbol and $(u)t$ is a rectangular transmit pulse of duration T.

In a practical transceiver, the DMT symbol (1) is generated by means of an inverse fast Fourier transform (IFFT) on the complex phasors $\{r_m^k\}, k \in [0, N-1]$ [4].

Fig. 1 shows the instantaneous amplitude $A(t)$ of two DMT symbols generated with two distinct sets of QAM-phasors $\{r_m^k\}_1$ and $\{r_m^k\}_2$, and $N = 256$. For both symbols, 16-QAM carrier modulation is assumed. A noticeable feature of the symbol in Fig. 1(b) as compared with the one in Fig. 1(a) is that it exhibits large amplitude spikes which arise when several frequency components add in-phase. These spikes may have a serious impact on the design complexity and feasibility of the transceiver's analog front-end (i.e., high resolution of D/A-A/D convertors and line drivers with a linear behavior over a large dynamical range). In addition, regulations can limit the peak envelope power or the probability of clipping [5]. The effect of amplitude clipping in DMT transceivers has

	been analyzed in the literature [6], [7] and methods based on encoding the input data in order to reduce the peak-to-average power ratio of the DMT signal have been proposed [8], [9]. The coding methods, however, require an increase in data rate and hence a reduction of the energy per bit for the same transmit power, resulting in performance degradation in terms of information handling capacity of the communication system. In this letter, an alternative method is proposed. Since N is usually large (say $N \geq 128$), $A(t)$ can be accurately modeled as a Gaussian random process (central-limit theorem) with a zero mean and a variance σ^2 equal to the total signal power. Its probability density function (pdf), denoted as $p(x)$, is given by [6] $$p(x) \cong \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-(x^2/2\sigma^2)}. \qquad (2)$$ Therefore, large amplitude spikes arise very rarely (thanks to statistical averaging) so that by applying a specific processing (no coding) only on DMT signals whose amplitudes exceed a given amplitude A_{Clip}, one can obtain a DMT symbol stream with almost no amplitudes exceeding A_{Clip}. *See, e.g.*, Mestdagh at 1234.

	The basic idea behind the proposed method can be described as follows. Assume that the maximum amplitude of the clipped DMT signal, A_{Clip}, is chosen so that the probability of amplitude clipping is lower than a specified value. In the DMT transmitter, the symbols generated by the IFFT are analyzed by a peak detector which provides an indication of the presence or absence of amplitude clipping. According to this indication, two distinct actions are taken: *Case a:* If the amplitude of the DMT symbol never exceeds A_{Clip}, then the symbol is sent to the transmitter front-end without any change. *Case b:* If the generated DMT symbol has at least one sample whose amplitude exceeds A_{Clip}, then it is not passed directly to the transmitter front-end. Instead, the phasor of each QAM-modulated carrier is changed by means of a fixed phasor-transformation and a new DMT symbol is generated by the IFFT. By careful selection of the phasor-transformation, the probability of clipping this new symbol (second pass) will be very low. (The resulting overall clipping probability will be calculated later on.)

	The receiver at the far-end is informed about the application (or not) of the phasor-transformation at the transmitter, and applies the inverse transformation (Case b) or not (Case a) after demapping the QAM-modulated carriers. This extra information requires only one bit per DMT symbol. This bit could be provided by modulation of the pilot tone that otherwise carries no information and that is permanently used to maintain synchronization. Forward error correction coding and/or duplication of this information over another or several tones can be envisaged to improve the reliability of this data recovery. Many phasor-transformations can be used. An easy-to-implement fixed random phasor transformation (known at the receiver) will be considered in what follows. Several other (more involved) transformations can be used as well without affecting the main results presented here. The overall probability of clipping with the "two-pass" method described above can readily be obtained using (2). *See, e.g.*, Mestdagh at 1234-35. We assume that due to the random phasor-transform (with large N), the probability that the symbol must be clipped after the second-pass, $P_{\mathrm{Clip}/2}$, is equal to $P_{\mathrm{Clip}/1}$. This is particularly the case if the transformation is a random bijection on the set of constellation points. This means that the sets of constellation points belonging to the sub-ensemble of clipped symbols are equiprobably transformed into the whole ensemble of DMT symbols. As the decision is taken after the first pass, only clipped symbols are submitted to a second pass, so that the overall clipping probability is given by $P_{\mathrm{Clip/Total}} = P_{\mathrm{Clip}/1} \cdot P_{\mathrm{Clip}/2} = P^2_{\mathrm{Clip}/1}.$ (5)

	See, e.g., Mestdagh at 1235-36. The SNR's (in dB) for $p = 0, 1$, and 2 derived from (15) are plotted in Fig. 3(a) as a function of μ for $\alpha = 2$, $b = 12$ b and $\nu = 25.9$ [(9) with $L = 4$ and $N = 256$]. It is seen that, as compared with the $p = 0$ case, an improvement in SNR is obtained provided that $\mu \geq 3.7$ for $p = 1$ and $\mu \geq 3.4$ for $p = 2$. This improvement in SNR can be used at profit to reduce the required resolution of the D/A-A/D convertors as discussed in [6]. *See, e.g.*, Mestdagh at 1238. A method to decrease the probability of clipping DMT symbols by several orders of magnitude has been described. The method does not use any kind of pre-coding and hence, does not increase the actual transmission data rate. Significant improvements in SNR of about 3 dB up to 8 dB as compared to the case or brute force clipping can be achieved. This can be used at profit to reduce the required resolution of the D/A-A/D convertors, to decrease the maximum amplitude of the transmitted signal, or to provide an extra signal-to-noise margin of the communication system. *See, e.g.*, Mestdagh at 1238. To the extent TQ Delta alleges that this limitation is not fully disclosed by Mestdagh, this element would have been obvious to one of ordinary skill in the art based on the state of the art in existence at the time, the explicit and implicit teachings of this reference and the art, the differences between the art and the claimed limitation and the general knowledge of a person of ordinary skill in the art. It was well known in the art to combine the phase shift computed for each respective carrier signal with the phase characteristic of that carrier signal to substantially scramble the phase

	characteristics of the plurality of carrier signals, wherein multiple carrier signals corresponding to the scrambled carrier signals are used by the first transceiver to modulate the same bit value. For example, each of the references in charts F4-008A – F4-008G; F4-008I – F4-008L; F4-008N – F4-008P and F4 Secondary - 008 teach this limitation. It would have been obvious to one of ordinary skill in the art to combine the teachings of Mestdagh with any of these references, as they all teach methods or devices that send the same data bits on different carriers and this was a known technique in the art used to achieve a lower BER. For additional motivation to combine see limitation 14[A].